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Augmented Reality-Based 3D Technology Learning Media for Human Respiratory Organs

Cherly Evanjeli[1], Novi Aryani Fitri[2], Yasir Arafat[3], Suharsono[4]

[1,2,3,4]*Program Studi Teknik Informatika, Politeknik Negeri Pontianak*
cherlyevanjelii@gmail.com[1], noviaryanif@polnep.ac.id[2], yasir.polnep00@gmail.com[3], suharsono@polnep.ac.id[4]

Abstract

Augmented Reality (AR) technology is selected for seamlessly integrating virtual objects into the real world. Users can represent objects in three dimensions, offering an interactive, real-time experience. The educational sector widely embraces Augmented Reality due to its interactive and timely advantages. This study focuses on the human respiratory system, demonstrating Augmented Reality's efficacy as an interactive learning tool for understanding respiratory organs. The learning material utilizes three-dimensional visualizations with animations, sound, and vibrant colors, enhancing comprehension and preventing boredom. Employing the Multimedia Development Method and software tools like Unity 3D, Blender, CorelDraw, Vuforia, and Visual Studio Code, the research produces a learning media application facilitating the understanding of human respiratory organs. Evaluation through questionnaires, with a 93.16% approval rate from teachers and students, confirms the application's suitability as an effective learning tool.

Keywords: *Augmented Reality (AR), Learning Media Application, Virtual object integration, Unity 3D, Blender*

1. Introduction

The current technological advancements have showcased remarkable progress, significantly impacting the field of education. The utilization of media through technology development in the present era is one of the factors influencing the learning process, although not fully realized. Technology can be leveraged as a supportive tool for learning, including augmented reality technology. Augmented reality, in essence, is a technology capable of integrating two or three-dimensional virtual objects into the real-world context and projecting them into that environment. Through augmented reality, media can display three-dimensional (3D) objects generated from materials that can be projected through a medium, such as markers facing the camera. This allows students to observe the images more clearly. The presentation of virtual objects in the real world is implemented on Android devices [1].

The contribution and role of instructional media in the educational process within the school environment hold high significance, particularly in the context of science subjects that often encompass abstract or challenging-to-observe concepts. Therefore, there is a need for media capable of simulating such content, as in the case of topics related to the human respiratory system. Augmented Reality can provide a three-dimensional simulation of the material, elucidating the structure and function of each complex respiratory organ.

Based on interviews conducted with the Natural Sciences teacher of Grade VIII at SMP Negeri 14 Satap Belimbing, Melawi Regency, there is one class with a total of 13 students. The learning media currently employed includes only the Curriculum 2013 textbook and PowerPoint presentations, with only five available textbooks. The suggested solution by the teacher is to allow students to bring smartphones to access e-books. Another challenge faced by the learning process at SMP 14 Satap Belimbing is the absence of a laboratory space, leading to a lack of tangible objects related to the human respiratory system that students can observe. Augmented Reality's role here is to facilitate students' understanding of the human respiratory system. The learning material in the textbook or e-book provided to students only presents images and text, making it difficult for students to comprehend the lesson and reducing their interest in learning due to the lack of varied learning media. However, by utilizing Augmented Reality, students can view 3D representations of respiratory organs and the human respiratory mechanism. As many students own smartphones, this Augmented Reality-based learning media can be used by students to observe visual representations of virtual objects related to human respiratory organs integrated into Android-based mobile devices.

Therefore, the solution in the form of a learning media application presented by this research can enhance the effectiveness of the educational process in schools and deepen students' understanding as learners in comprehending the human respiratory organ system. With the presence of this learning media, it is expected that the issues encountered in the learning process so far will be addressed more easily for students, and it will assist teachers in providing explanations during lessons on the topic of the human respiratory system.

2. Literature Review

Several studies have utilized Augmented Reality in the creation and development of interactive learning media. One such study is conducted by Aga Arsari and Qadhli Jafar Adrian, titled "Implementation of Augmented Reality in The Art Of Animation: 12 Principles." From the questionnaire calculations, an interpretation of the total score for the utility aspect was obtained at 90%, indicating that the application is considered suitable for use in the category of Very Suitable [2].

The second study was carried out by Isna Alfiana and Sugeng Purbawanto, titled "Learning Media for the Human Respiratory System using Android-based Augmented Reality." The results of this research showed a score of 95.7%, indicating that the implementation of the application contributed to an improvement in students' learning outcomes [3]. The third study was conducted by Muhammad Zaky Taufiq, titled "Application of Augmented Reality Technology in Learning the Nervous System, Brain Section." The AR application testing yielded satisfactory results, with a functionality score of 96% [4]. The fourth study was conducted by Viktor Handrianus Pranatawijaya, titled "Implementation of Augmented Reality in Restaurant Menus."Results from black-box testing, as assessed through questionnaires, indicated an Excellent category with a score of 87% for this application" [5].

3. Method

To address the research problems, the applied method is the Multimedia Development Life Cycle (MDLC). This method comprises six stages: Concept, Design, Material Collecting, Assembly, Testing, and Distribution.

3.1. Concept

In the development of the Augmented Reality application, several concepts are implemented by determining purpose, objectives, and goals by analyzing system requirements. In this stage, the concept of creating an appealing and demand-specific application will influence the audience or user's interest. In this research, the main user identification for the application is middle school students, particularly in Grade VIII for the Science subject. The type of application to be created is interactive multimedia to serve as an alternative learning media. By presenting 3D objects through Augmented Reality, students can be assisted in developing new understandings, enabling more immersive participation in the surrounding environment, thus allowing information to be obtained with optimal clarity [6].

3.2. Design

Design is the process of planning the aspects or elements of an entity to achieve specific goals optimally and effectively. In this stage, the author creates the interface and navigation structure. The navigation flow design is used to determine the menu flow in the application. The navigation flow of the learning media application, where the application begins with the splash screen and has the main menu, namely the AR Start menu. The navigation structure of the AR application is illustrated in Figure 1

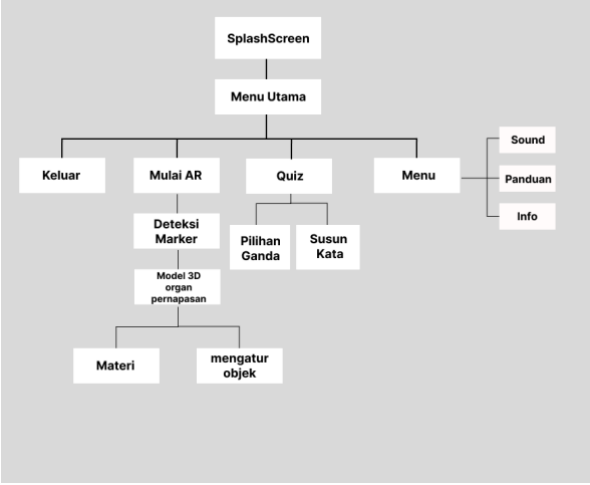

Fig. 1: Navigation Structure

3.3. Material Collecting

The material collection stage, referred to as Material Collecting, is conducted according to the requirements, where the collected materials include text and 3D images created using Blender.

3.4. Assembly

The fourth stage in this process is the assembly stage, where the preparations made earlier will be applied comprehensively as an application and created in APK format. The development of this application is carried out using Unity as the game engine and utilizing the C# programming language. The creation of 3D objects in Unity is done using Blender.

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Fig. 2: Creating 3D Objects

One key aspect of creating this application is the process of crafting 3D objects, as shown in Figure 3, carried out through the use of Blender software. The integration between the Unity and Blender platforms plays a crucial role in ensuring the coherence and sustainability of the Augmented Reality application under development.

Fig 3: Assets for Application

3.5. Testing

Testing for this application is conducted using the black-box testing method, an approach to software testing that focuses on evaluating the inputs entered and the resulting outputs. The main goal is to test the functionality and identify errors if there are any display issues. Testing is carried out on various versions of Android. The results of the testing on Android versions and black-box testing can be seen in Table 1 and Table 2 below.

Table 1: Black Box Testing of Android Versions

No	Android Version	Device Tested	Results
1	Android version 8	Redmi 5+	Compatible with Android version 8
2	Android version 9	VIVO Y12	Compatible with Android version 9
3	Android version 10	Samsung Galaxy A12	Compatible with Android version 10
4	Android version 11	REALME V2	Compatible with Android version 11

Table 2: Black Box Testing

No	Test Scenario	Expected Outcome	Test Result
1.	Pressing the "Start" menu	Moving to the AR scene	Successful
2.	Pressing menu buttons	Displaying audio, guidance, and information	Successful
3.	Pressing the "audio" button	Enabling and disabling music	Successful
4.	Pressing the "guidance" button	Moving to the guidance page	Successful
5.	Pressing the "info" menu	Moving to the info page	Successful
6.	Pressing the "quiz" button	Moving to the scene before entering the quiz	Successful
7.	Pressing the "exit" button	Exiting the application	Successful
8.	Pressing the "Home" button	Returning to the main menu	Successful
9.	Hiding the Scan panel when the marker is detected	The Scan panel is not visible when the 3D object appears	Successful
10.	Detecting the Marker	The 3D object appears when the camera is directed at the marker	Successful
11.	Pressing the button on the 3D object marker	Explanation of the material appears	Successful
12.	Pressing the cross button on the text material explanation	Text and audio material explanation disappears Successful	Successful
13.	Pressing the Multiple Choice Quiz button	Entering the Multiple Choice Quiz scene	Successful
14.	Pressing the Word Arrangement Quiz button	Entering the Word Arrangement Quiz scene	Successful
15	Pressing the Audio button	Enabling and disabling music sound	Successful
16.	Pressing the "back" button	Moving to the previous Quiz scene	Successful
17	Pressing the "Answer Options" button	Notification panel appears and moves to the next question	Successful
18.	Pressing the "back" button	Moving to the previous Quiz scene	Successful
18.	Pressing the "Check" button	The application produces a correct/incorrect sound. If the answer is correct, the question will change, and the score will increase	Successful
19.	Pressing the "Reload" button	The letter fill box reloads the answer	Successful

3.6. Distribution

The final stage is distribution, where the application, having undergone testing and deemed suitable for use, can be stored in storage devices such as flash drives, CDs/DVDs, hard drives, or in the cloud through G-drive. In this stage, the application, having undergone testing, will be distributed to teachers and students in the form of an Android operating system application.

4. RESULTS AND DISCUSSION

This research activity resulted in an Android-based Application Using Augmented Reality for Learning the Human Respiratory System. In the initial section of the application, the main menu is displayed, containing several buttons to navigate to the next scenes and audio features. The view of the main menu application can be seen in Figure 5.

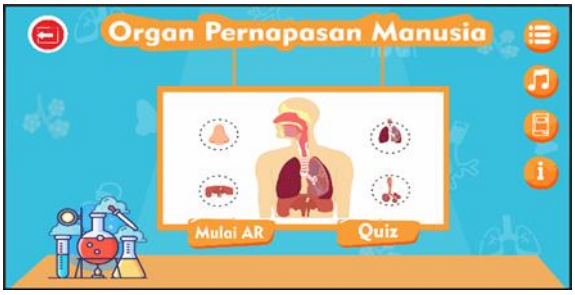

Fig. 4: Main Menu

To view the 3D objects of the human respiratory system, users can select the Start AR button, and the application will begin loading. The 3D objects can be displayed according to the provided marker. The loading page view can be observed in Figure 6.

Fig. 5: Loading View

After the loading process is complete, the application will immediately access the smartphone camera, displaying the AR scan sign used to detect the marker of the 3D object. This page also contains a home button used to return to the main menu of the application. Figure 7 shows the view of the AR scan camera on Android.

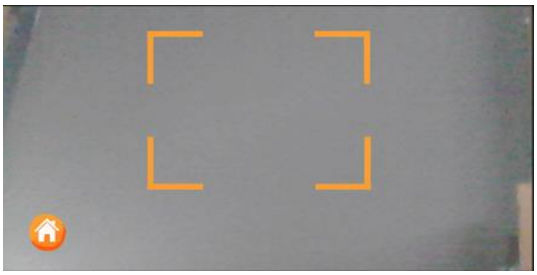

Fig. 6: AR Camera

To display the 3D object, users can point the camera at the desired marker. The following is an image of the existing marker.

Fig. 7: Marker

After the camera successfully detects one of the marker objects, the 3D Human Respiratory System object will appear. Each 3D object has a number on the image, where each number contains the name and explanation in the form of text along with an audio explanation of the human respiratory organ. When the 3D object is detected, it can be seen in Figure 9.

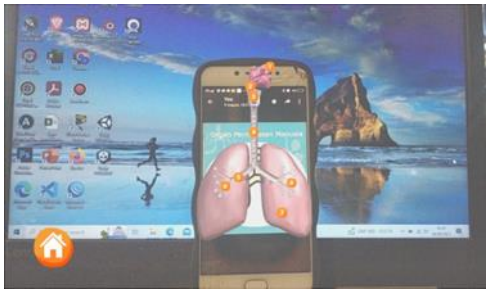

Fig. 8: 3D Object of the Solar System

The following is the display of the material explanation for each number on the respiratory organ.

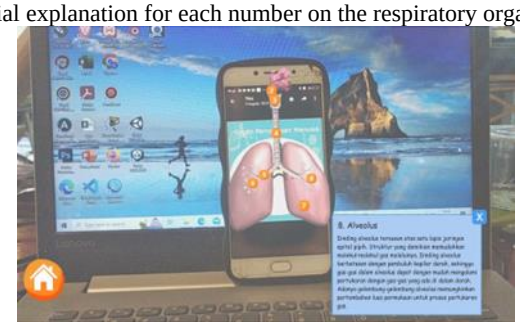

Fig. 9: Material of the 3D Object of the Human Respiratory System

Application Questionnaire; Questionnaire data is a data collection tool needed in this testing to obtain feedback from application users. The questionnaire data was filled out by 13 respondents, consisting of 1 Science teacher and 12 students. This data also serves as a benchmark for the application's suitability as a learning medium. The results of the conducted questionnaire can be seen in Table 3.

Table 3: Questionnaire

No	List of Questions	Agree	Average	Disagree
1.	Do the buttons in the application function properly?	13	0	0
2.	Does the application run according to the available buttons?	13	0	0
3.	Can students easily understand the material when using the application?	12	0	1
4.	Does this application make it easier for teachers to deliver the material?	13	0	0
5.	Is this application suitable for use in teaching and learning activities?	13	0	0
6.	Is the application's display attractive?	10	2	0
7.	Is the material in the application consistent with what is in the book?	11	2	0
8.	Does the application provide all the necessary functions?	13	0	0
9.	Is this application satisfying overall?	12	1	0
	Presentase	**93,16%**	**4,27%**	**0,85%**

Based on the results of the questionnaire calculations above, the total approval regarding this learning application is obtained at 94.9%, indicating that this augmented reality application can be utilized and used as a learning aid for the topic of the human respiratory system.

5. Conclusion

Based on the implementation and test results, the conclusion drawn is that the researcher has successfully developed an Augmented Reality application for interactive learning of the human respiratory system that runs well and functions as intended. This application can also display illustrations in the form of 3D objects of the respiratory organs and provide explanations for the material in both text and audio formats.

References

[1] I. Mustaqim, “Pemanfaatan Augmented Reality Sebagai Media Pembelajaran,” Jurnal Pendidikan Teknologi dan Kejuruan, vol. 13, 2016. DOI: https://doi.org/10.23887/jptk-undiksha.v13i2.8525

[2] Q. J. A. Aga Arsari, “Implementasi Augmented Reality Pada Buku "The Art Of Animation : 12 Principles",” Jurnal Informatika dan Rekayasa Perangkat Lunak (JATIKA), vol. 1, pp. 109-119, 2020. DOI: https://doi.org/10.33365/jatika.v1i1.230

[3] S. P. Isna Alfiana, “Media Pembelajaran Sistem Pernapasan Manusia dengan Pemanfaatan Augmented Reality Berbasis Android,” Edu Elektrika Journal, vol. 10, 2021. DOI https://doi.org/10.15294/eej.v10i2.51791

[4] M. Z. Taufiq, “Penerapan Teknologi Augmented Reality Pada Pembelajaran Sistem Saraf Bagian Otak,” ELIT Journal Electrotechnics And Information Technology, vol. 3, 2022.

[5] V. H. Pranatawijaya, “Implementasi Augmented Reality Pada Menu Rumah Makan,” Jurnal Teknologi Informasi, vol. 14 No 1, 2020. DOI: https://doi.org/10.47111/jti.v14i1.628

[6] A. I. R. A. P. Mohammad Badri, “Implementasi Augmented Reality Pada Media Pengenalan Prodi Sistem Informasi FST UINSU Medan,” Jurnal Teknologi dan Sistem Informasi Univrab, vol. 7 No. 2 , pp. 109-121, 2022. DOI: https://doi.org/10.36341/rabit.v7i2.2412